Astrophysics, Astrochemistry, Particle Physics, and the Natural Universe

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●[illegible]1. [illegible](X^n)^\prime = nX^{n-1} [illegible](\sin X)^\prime = \cos X [illegible](\cos X)^\prime = -\sin X [illegible]2. [illegible]\int x^n dx = \frac{1}{n + 1}x^{n + 1} + C [illegible]n\neq -1[illegible]\int \sin x dx = -\cos x + C [illegible]\int \cos x dx = \sin x + C [illegible]1. [illegible]\frac{\partial^2 u}{\partial t^2} = a^2 \frac{\partial^2 u}{\partial x^2} [illegible]2. [illegible]\frac{\partial u}{\partial t} = a^2 \frac{\partial^2 u}{\partial x^2} [illegible]3. [illegible]\Delta u = 0 [illegible]

[illegible]1. [illegible]\Delta u = f(x,y,z)[illegible] f(x,y,z) [illegible]2. [illegible]\Delta u + k^2 u = 0[illegible]3. [illegible]\frac{\partial u}{\partial t} + \vec{v} \cdot \nabla u = 0[illegible]4. [illegible] i\hbar\frac{\partial \Psi}{\partial t} = -\frac{\hbar^2}{2m}\nabla^2 \Psi + V\Psi [illegible]5. [illegible]\frac{\partial u}{\partial t} = D \Delta u [illegible]

[illegible]1. [illegible]- [illegible]- [illegible]- [illegible]2. [illegible]- [illegible]- [illegible]3. [illegible]- [illegible]- [illegible]4. [illegible]- [illegible]- [illegible]5. [illegible]- [illegible]- [illegible]

●[illegible]1. telegraph [illegible]\frac{\partial^2 u}{\partial x^2} = LC\frac{\partial^2 u}{\partial t^2} + (RC + LG)\frac{\partial u}{\partial t} + RG u [illegible]2. Klein-Gordon [illegible]\frac{\partial^2 \varphi}{\partial t^2} - \nabla^2 \varphi + m^2\varphi = 0 [illegible]3. Boussinesq [illegible]4. [illegible]5. [illegible]\frac{\partial u}{\partial t} = D \Delta u + f(u) [illegible]

●[illegible]1. Telegraph [illegible]- [illegible]- [illegible]2. Klein-Gordon [illegible]- [illegible]- [illegible]3. Boussinesq [illegible]- [illegible]- [illegible]4. [illegible]- [illegible]- [illegible]5. [illegible]- [illegible]- [illegible]

●[illegible]1. [illegible]PV = nRT[illegible] P [illegible]V [illegible] n [illegible]R [illegible]T [illegible]2. [illegible]v = \frac{\Delta c}{\Delta t}[illegible]1. [illegible]\frac{a^3}{T^2} = GM/4\pi^2[illegible] a [illegible]T [illegible]G [illegible]M [illegible]1. [illegible]-[illegible]4p \to ^4He + 2e^+ + 2\nu + 26.7 MeV [illegible]1. [illegible]v = H_0d[illegible] v [illegible]d [illegible]H_0 [illegible]

●[illegible]1. [illegible]E = mc^2[illegible] E [illegible]m [illegible]c [illegible]1. [illegible]F = G\frac{m_1m_2}{r^2}[illegible] F [illegible]G [illegible] m_1[illegible]m_2 [illegible]r [illegible]

●MATLAB [illegible]1. [illegible]2. [illegible]3. [illegible]4. [illegible]5. [illegible] MATLAB [illegible]A = [2, 1; 1, 2];b = [4; 5];x = A\b;disp(x);[illegible]x = 0:0.1:2*pi;y = sin(x);plot(x,y);[illegible]MATLAB [illegible]

[illegible] MATLAB [illegible] polyfit [illegible] fit [illegible] polyfit [illegible]% [illegible] x = 0:0.1:10;y = 2*x + 3 + randn(1,length(x))*2; % [illegible]% [illegible]p1 = polyfit(x, y, 1);y_fit1 = polyval(p1, x);% [illegible] p2 = polyfit(x, y, 2);y_fit2 = polyval(p2, x);% [illegible] plot(x, y, 'o', x, y_fit1, x, y_fit2);legend('[illegible]', '[illegible]', '[illegible]');[illegible] fit [illegible]% [illegible] f = fittype('a*exp(b*x)', 'independent', 'x', 'parameters', {'a', 'b'});% [illegible] fitresult = fit(x', y', f);% [illegible] a = fitresult.a;b = fitresult.b;% [illegible] y_fit = a*exp(b*x);% [illegible] plot(x, y, 'o', x, y_fit);[illegible]

●[illegible]1. [illegible]-1/2 [illegible]2. [illegible]-[illegible]$E^2 = p^2c^2 + m^2c^4$[illegible] E [illegible]p [illegible]m [illegible]c [illegible]3. [illegible]$\Delta x \Delta p \geq \frac{\hbar}{2}$ [illegible] Δx [illegible]Δp [illegible]$\hbar$ [illegible]

[illegible]1. [illegible]-[illegible]Klein-Gordon Equation[illegible] 0 [illegible]2. [illegible]QED[illegible]3. [illegible]4. [illegible]-[illegible]Yang-Mills Equations[illegible]5. [illegible]

●[illegible]$\frac{a^3}{T^2} = GM/4\pi^2$ [illegible]$F = G\frac{m_1m_2}{r^2} = m_1a$ [illegible]F [illegible]r [illegible]a [illegible] Runge-Kutta [illegible]

[illegible]1. [illegible]-[illegible]Titius-Bode Law[illegible]2. [illegible]3. [illegible]4. [illegible]

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Astrophysics, Astrochemistry, Particle Physics, and the Natural Universe ● Astronomy Astrophysics Astrophysics, Astrophysics, Particle Physics, Cosmology has a wide range of fields and profound connotations. Although mankind has made many great discoveries and made great achievements today, there are inevitably various fallacies, omissions, omissions and even mistakes. This requires human beings to constantly reflect, follow up and revise, in order to truly understand the true meaning and original appearance of the material world. The natural universe is changeable and wonderful, and the rational judgment, cognition and perception of human beings need to be constantly innovated step by step. The history of human cognition may be higher than the whole history of the natural universe and more or less lower than the history of the natural universe. ● The main formulas of advanced mathematics include: 1. Basic formulas of derivatives, such as: (x n) \ prime = NX {n-1}, (\ \sin X)^\prime = \ cos X x, (\ cos x) \ prime =-\ sin x, etc. 2. Basic formula of integral, such as: \ int x n dx = \ frac {1} {n+1} x {n+1}+c (n \ neq-1), \int \sin x dx = -\cos x+C, \ int \ cos x dx. Mathematical and physical equations refer to partial differential equations derived from physical problems, and the common ones are: 1. Wave equations: \ frac {\ partial 2u} {\ partial t 2} = a 2 \ frac {\ partial 2u} {\ partial x 2}, which describe string vibration and electromagnetic wave propagation. 2. Heat conduction equation: \ frac {\ partial u} {\ partial t} = a 2 \ frac {\ partial 2u} {\ partial x 2}, which is used to describe the heat conduction process. 3. Laplace equation: \Delta u = 0, which has applications in electrostatic field, fluid mechanics and other fields. These are only a small part of higher mathematics and mathematical physics equations, and their theories and applications are very extensive and in-depth. In addition to the wave equation, heat conduction equation and Laplace equation mentioned above, the common mathematical and physical equations include: 1. Poisson equation: \Delta u = f(x,y,z), where f(x,y,z) is a known function. 2. Helmholtz equation: \ delta u+k 2 u = 0, which has important applications in electromagnetism, acoustics and other fields. 3. Transport equation: \ frac {\ partial u} {\ partial t}+\ vec {v} \ cdot \ nabla u = 0, which is used to describe the transport phenomenon of substances. 4. Schrodinger equation: I \ hbar \ frac {\ partial \ psi} {\ partialtt} =-\ frac {\ hbar 2} {2m} \ nabla 2 \ psi+v \ psi, which is the basic equation in quantum mechanics. 5. Diffusion equation: \ frac {\ partialeu} {\ partialet} = d \ delta u,

used to describe the diffusion process. These equations play a vital role in physics, engineering, mathematics and other fields, helping us to understand and solve various practical problems. There are many ways to solve mathematical and physical equations. Here are some common methods for you: 1. Separation of variables:-Assuming that the solution can be expressed as the product of several variables. -Separate the equation into ordinary differential equations with only a single variable. -Solve these ordinary differential equations separately and get general solutions. 2. Fourier transform method:-Fourier transform the two sides of the equation to convert the partial differential equation into the ordinary differential equation. -After solving the ordinary differential equation, inverse Fourier transform is performed to get the solution of the original equation. 3. Laplace transform method:-Similar to Fourier transform, time variables are laplace transformed. -Solve the transformed equation, and then perform the inverse Laplace transform. 4. Green's function method:-First find the Green's function corresponding to the homogeneous equation. -Using Green's function to solve the nonhomogeneous equation. 5. Numerical methods:-For example, the finite difference method discretizes continuous space and time variables and establishes a difference equation to approximate the original equation. -Finite element method, which divides the solution area into finite elements, and establishes an equation to solve the problem through variational principle. To solve mathematical and physical equations, it is often necessary to choose appropriate methods according to the characteristics and boundary conditions of specific equations, and sometimes it is necessary to use a combination of multiple methods. ● There are several important mathematical and physical equations: 1. telegraph equation (telegraph equation): \ frac {\ partial 2u} {\ partial x 2} = LC \ frac {\ partial 2u} {\ partial t 2}+(RC+LG) \ frac { 2. Klein-Gordon equation: \ frac {\ partial 2 \ var phi} {\ partial t 2}-\ nabla 2 \ var phi+m 2 \ var phi = 0, which plays an important role in relativistic quantum mechanics. 3. Boussinesq equation: used to describe shallow water waves and other phenomena. 4. Nonlinear Schrodinger equation: It has applications in nonlinear optics and other fields. 5. Reaction-diffusion equation: \ frac {\ partial u} {\ partial t} = d \ delta u+f (u), which is used to describe the system including reaction and diffusion processes. These equations have extensive application and research value in different scientific and engineering fields. ● The following are some concrete applications of these mathematical and physical equations in practice: 1. Telegraph equation:-It is used to analyze the voltage and current propagation characteristics in long-distance transmission lines and help optimize the design and stability analysis of power transmission systems. -In the communication field, it is used to study the transmission and distortion of signals in cables. 2. Klein-Gordon equation:-In high-energy physics, it helps to understand the behavior and interaction of elementary particles. In relativistic astrophysics, it can be used to study the characteristics of fields and particles near black holes. 3. Boussinesq equation:-Used to predict shallow water wave propagation in the ocean, which is of great significance to coastal engineering, port design and tsunami warning. -Helping to design rivers, dams and channels in water conservancy projects. 4. Nonlinear Schrodinger equation:-It is used to describe the propagation of optical pulses in

optical fibers, which is very important for the optimization and design of optical communication systems. -In plasma physics, it is helpful to study the wave phenomenon in plasma. 5. Reaction-diffusion equation:-In chemistry, substance diffusion and concentration change in chemical reaction can be simulated. -In biology, it is used to describe the spread and growth of biological populations, such as the transmission model of infectious diseases. In a word, these mathematical and physical equations play an important role in physics, engineering, biology, chemistry and many other fields, providing theoretical basis and analytical tools for solving practical problems. ● Important formulas in advanced chemistry, astrophysics, astrochemistry and cosmophysics: advanced chemistry: 1. Equation of state of ideal gas: PV = nRT, where P is pressure, V is volume, N is the quantity of matter, R is gas constant and T is temperature. 2. chemical reaction rate formula: $v = \frac{\Delta c}{\Delta t}$, which is used to express the reaction rate. Astrophysics: 1. Kepler's third law: \ frac {a 3} {t 2} = GM/4 \ pi 2, where a is the semi-major axis of the orbit of the planet, t is the period of revolution, g is the gravitational constant, and m is the mass of the central celestial body. Astrochemistry: 1. Formula of energy generation in stars (proton-proton chain reaction): 4p \ to 4he+2e++2 \ nu+26.7 MeV Cosmology: 1. Hubble Law: $v = H_0d$, where v is the retrogression velocity of galaxies, d is the distance of galaxies, and H_0 is Hubble constant. These are only a few of them, and there are many complicated and important formulas in each field. The specific application needs to be combined with the actual situation and in-depth study and research. ● In particle physics, some important formulas include: 1. Mass-energy equation: $E = mc^2$, where E represents energy, M represents the mass of the object, and C represents the speed of light in vacuum. Important formulas in celestial mechanics are as follows: 1. Formula of the law of universal gravitation: f = g \ frac {m_1m_2} {r 2}, where f is the gravitational force between two objects, g is the gravitational constant, m _ 1 and m _ 2 are the masses of two objects respectively, and r is the distance between the centroids of two objects. These are only some important formulas in these two fields. In fact, there are many complicated and in-depth formulas and theories. ●MATLAB is a powerful mathematical software, which is widely used in scientific calculation, data analysis, algorithm development, image processing, control system design and many other fields. It has the following remarkable characteristics and advantages: 1. Strong mathematical calculation ability: it can perform matrix operation, numerical analysis, symbolic calculation and other mathematical operations. 2. Rich toolbox: covering various professional fields, such as signal processing, optimization, statistics, machine learning, etc. 3. Visualization function: You can easily draw high-quality 2D and 3D graphics, which helps to intuitively understand data and results. 4. Flexible programming: support a variety of programming methods, including scripts, functions and object-oriented programming. 5. Good documentation and support: there are detailed help documents and active user communities to facilitate users' learning and communication. For example, if you want to solve a system of linear equations, you can use the following MATLAB code: A = [2, 1; 1, 2]; b = [4; 5]; x = A\b; disp(x); If you want to draw a sine function curve: x = 0:0.1:2*pi; y = sin(x); plot(x,y); In a word, MATLAB provides an efficient and convenient tool and

environment for research and development in mathematics and engineering. In MATLAB, polyfit function can be used for polynomial fitting, and fit function can be used for more complex fitting types. The following is an example of polynomial fitting using polyfit function:% generating sample data x = 0:0.1:10; y = 2*x + 3 + randn(1,length(x))*2; % add some noise% for a polynomial fitting (straight line fitting) p1 = polyfit(x, y, 1); y_fit1 = polyval(p1, x); % for quadratic polynomial fitting p2 = polyfit(x, y, 2); y_fit2 = polyval(p2, x); % Plot original data and fitting curve (x, y,' o', x, y _ fit1, x, y _ fit2); Legend ('original data',' primary fitting',' secondary fitting'); If you want to do more complex fitting, such as nonlinear fitting, you can use the fit function or the corresponding toolbox. For example, for exponential fitting, you can do this:% define the exponential function model f = fittype ('a * exp (b * x)',' independent',' x',' parameters', {'a',' b'}); % fitresult = fit(x', y', f); % get the fitting parameter a = fitresult.a; b = fitresult.b; % calculate fitting value y_fit = a*exp(b*x); % Plot results (x, y,' o', x, y _ fit); You can choose the appropriate method according to the specific data and fitting type. ● In particle physics, the following formulas are widely used in practical research: 1. Dirac equation: describes the behavior of spin -1/2 particles (such as electrons) in relativistic quantum mechanics. 2. Energy-momentum relationship: E 2 = P 2C 2+M 2C 4, where E is energy, P is momentum, M is the static mass of particles, and C is the speed of light in vacuum. 3. Heisenberg uncertainty principle: \Delta x \Delta p \ geq \ frac {\hbar} {2}, where \ delta x is the uncertainty of position, \ delta p is the uncertainty of momentum, and \ hbar is the reduced Planck constant. These formulas are of great significance for understanding the properties and behaviors of particles and related physical phenomena and experimental results. In particle physics, the following equations are also important: 1. Klein-Gordon Equation: used to describe particles with zero spin, such as mesons. 2. Renormalization equation in quantum electrodynamics (QED): dealing with divergence in quantum field theory. 3. Fermi interaction equation in weak interaction: It plays an important role in understanding the weak interaction process. 4. Yang-Mills Equations are the basic equations to describe the gauge fields such as strong interaction. 5. Equations related to Higgs mechanism: used to explain how particles gain mass. ● In celestial mechanics, it usually takes the following steps to calculate the trajectory of celestial bodies by using relevant formulas: First, determine the basic parameters of the celestial body system under study, such as the mass, initial position and initial velocity of the celestial body. Take Kepler's law and the law of universal gravitation as examples. Kepler's third law: \ frac {a 3} {t 2} = GM/4 \ pi 2, which can be used to mutually calculate these parameters when the semi-long axis and period of the orbit of a celestial body and the mass of the central celestial body are known. For calculating the specific trajectory of celestial bodies, Newton's second law is usually combined with the law of universal gravitation: f = g \ frac {m _ 1m _ 2} {r 2} = m _ 1a, where f is the gravitational force between two celestial bodies, r is the distance between the centroids of the two celestial bodies, and a is the acceleration of the celestial bodies. Then, the above equation is transformed.